ID	Presentation Title	Lecturer	Question	Answer
01-02	J-CROS activities	Hiroshi Tsuji	I was wondering if you use Simultaneous Integrated Boost (SIB) technique.	Thank you for the quetion. At present, we usually use a boost PTV in fractionated treatment. Recently we started to use the SIB in a few tumors, e.g. pancreas cancer as a clinical trial. When we apply very hypofractionation in wide variety of cancer, we will use SIB or biological optimization by multi-ion therapy.
02-04	Biological effects of fractionation	Yukari Yoshida	1) I am a little confuse about the SOBP and plateau. Aren't they the same? Or SOBP just a specific Bragg peak in the plateau? 2) Yes, probably it is the English problem. Because the plateau phase to me is the highest region of a curve, I am thinking if plateau is just identical to SOBP? However, I also heard that plateau of CIRT is actually the area right before SOBP. I am not very sure though. Thank you for your answering.	1) Thank you for your question. Precisely, it is the plateau region and the SOBP region in the SOBP beam. Does this answer your question? 2) Sorry for the confusion. In this lecture, I used the term "plateau" to indicate the low LET (about 13 keV/um) region before the SOBP, or "entrance region". Your confusion is understandable since the SOBP also appears to be plateau-like.
02-05	Precision Carbon Ion Radiotherapy	Takahiro Oike	I am a little confuse about the SOBP and plateau. Aren't they the same? Or SOBP just a specific Bragg peak in the plateau?	Thanks for the question. As I screened the speech draft for my presentation, I was not able to find the term "plateau" used in my presentation. Nevertheless, I probably understand what you asked. Some heavy-ion scientists use the term "plateau" indicating the "entrance region"; i.e., the low LET (approx. 13 keV/um) region before SOBP. I understand your confusion because SOBP also looks like plateau-shaped. To avoid the confusion, I prefer to use "entrance region", SOBP, and "tail".
02-05	Precision Carbon Ion Radiotherapy	Takahiro Oike	Thank you for the response. I am sorry that my question should be for Dr. Yoshida about the radiation fractionation. I still learned a lot from your answers. Thank you again.	No. apologies. Thanks for watching my video :)
02-08	Biological Aspects of FLASH Particle Therapy	Teruaki Konishi	How can I take advantage of the FLASH effect In Carbon ion therapy ?	Unfortunately, we do not have the specific answer for your question. Currently, we are investigating whether the Carbon ions would have FLASH effect or not. As I mentioned the results of ours in the slides, physico-chemical stage of ultra high dose rate exposure have shown reduction of indirect action which is a cause of DNA damage. Also a group in Germany have shown the reduced effect in cell killing in mammalian cells. I must note that we are in stage of gathering evidence of carbon-FLASH effect. In case of treatment planning, there are many other factors that are need to be considered, such as beam pulse width, dose rate, oxygen concentration in tissues, and tissue specific radio sensitivities. Also, we have to consider immunological response of the patients, eg. conventional exposure would have 100 % of blood cells exposed to the beam but with ultra-high dose rate some researchers have reported that nearly 90% of blood cells can escaped from exposure. This means that UHDR exposre has the potential to maintain the patients immunity. This part I did not mention in the presentation slides. One more thing, with UHDR, the traditional 4R in radiation therapy is not applicable. We must construct a new rules for UHDR-FLASH therapy. What I want to say, it that we have a lot (at least 5~10 years of work) to clarify from the radio-biological point of view. Thanks for asking!

ID	Presentation Title	Lecturer	Question	Answer
03-01	Accelerators for CIRT and Quantum Scalpel	Yoshiyuki Iwata	Thank you for the presentation. When is it scheduled to be fully operated the Quantum Scalpel project? I was wondering if you could provide us more information about Laser-driven ion accelarator. How power is it?	Thank you for your question. As mentioned in the presentation, construction of the quantum scalpel in QST has started and is scheduled to complete by FY2025. From FY2026, commissioning will be conducted, and the quantum scalpel would be in clinical operation from FY2027. The laser-driven ion accelerator is being developed at Kansai Photon Science Institute of QST, and the research and development projects to develop the new laser system, targets and beam transport line are underway. The intensity of the laser system is currently designed to be 10^{20} W/cm^2 with repetition rate of 10 Hz, and the energy on a target is approximately 1 J. Further, the laser intensity is planned to be increased up to 10^{21} W/cm^2 by FY2026. The beam tests of the laser acceleration are being conducted in parallel by using the existing laser system, J-Karen, as a proof of principle. With the laser power of 9 J on target, we could successfully observe 4x10^7 carbon ions/pulse having the energy of 4 MeV/u.
03-01	Accelerators for CIRT and Quantum Scalpel	Yoshiyuki Iwata	What is progress and timeline to implementation of laser driven ion injector.	Thank you for the question. The laser-driven ion accelerator is being developed at Kansai Photon Science Institute of QST, and the research and development projects to develop the new laser system, targets and beam transport line are underway. The intensity of the laser system is currently designed to be 10^{20} W/cm^2 with repetition rate of 10 Hz, and the energy on a target is approximately 1 J. Further, the laser intensity is planned to be increased up to 10^{21} W/cm^2 by FY2026. The beam tests of the laser acceleration are being conducted in parallel by using the existing laser system, J-Karen, as a proof of principle. With the laser power of 9 J on target, we could successfully observe 4x10^7 carbon ions/pulse having the energy of 4 MeV/u. These research and development projects will be completed by the end of FY2026, and the implementation of the laser-driven ion accelerator will be made from FY2027.
03-01	Accelerators for CIRT and Quantum Scalpel	Yoshiyuki Iwata	Thank you for answering my question (question 1). I was wondering, if you could explain us briefly, why do you choose to use these four specific ions (Carbon, Helium, Oxygen, Neon) for Quantum Scalpel. I already knew about Carbons. What about the other three ions. What is the Radiobiological effectiveness of these ions?	Thank you again for the question. As presumably discussed in Dr. Inaniwa's presentation, we are studying a new therapeutic technique using various ion species in single treatment session for optimizing both the physical dose and LET distribution in a patient. The goal of this study is to control the tumors while preserving the normal tissues. This goal is generally accomplished by designing the biological dose distribution to deliver a large enough dose to the tumor while sparing the organs at risk (OARs); that is, heavy ion beams of oxygen or neon ions will be used for tumor, while lighter ions of helium will be applied for boundary with normal tissue. For the lighter ion, helium would be the best choice because it's easy to handle (lithium and beryllium are toxic, and boron is too close to carbon). For the heavier ions, we chose oxygen and neon ions considering easy handling and availability. Further, the range of ions heavier than neon might be insufficient for clinical use since the maximum energy of the quantum scalpel is limited to 430 MeV/u (the water range of neon ion having 430 MeV/u is 185 mm).
03-01	Accelerators for CIRT and Quantum Scalpel	Yoshiyuki Iwata	Thank you for your responce. Really, appreciate it. Your answer was more than briefly, as I mentioned. I think now, I have clarified many things in my mind. If I remember well (correct if I am wrong), in ITCCIR2020, in your slide presentation, you had a very representative image describing exactly the same thing as you mentioned at the end of your first paragraph. That image was so helpful. You didn't add it this year. I have another two questions if you dont' mind. 1) What it will be the maximum treated depth for deep seated tumors using Quantum Scalpel. 2) As you mentioned, helium will be applied for boundary with normal tissues. I was wondering, if you could explain me how this will happened, practically, without irradiating the tumour or the center of it.	1) Since carbon beams having the energy of 430 MeV/u are basically used for treatment, the maximum treated depth for the quantum scalpel is same as that of HIMAC and the other compact carbon facilities, build in Japan. The other beams of helium, oxygen and neon ions would be used as needed to treat intractable cancers, such as pancreatic cancers, etc. 2) As mentioned previously, carbon beams will be basically used for treatment. The heavier beams of oxygen and neon ions will be used to enhance LET distribution over the core of tumor, while the lighter beam of helium ion will be applied for boundary with normal tissues if OAR is located around the boundary. For more information for multi-ion treatment, please review the following reference: T. Inaniwa et al., Phys. Med. Biol. 62 5180 (2017).
03-02	Beam delivery, QA (inc. J-CROS)	Hideyuki Mizuno	Thank you for the presentation. Which one of the three lateral scanning techniques is most preferably in clinic?	Energy scanning is the preferred technique because the beam size is constant. However, it requires precise accelerator control. If the beam size is properly considered in TPS, other techniques are of course acceptable.
03-05	Motion management & IGRT with in-room CT	Makoto Sakai	Thanks for the nice presentation. For lung cancer treatment in your center, can in-room CT replace the fiducial markers completely? If the answer is no, please explain why.	Thank you for your question. In the case of lung cancers, the markers we used in the past were prone to drop out or migrate. Therefore, markers could not accurately represent tumor migration and could not replace CT imaging. If the shape and material of the markers are improved, so that the new markers do not migrate close to the tumor and do not interfere with treatment planning due to the artifacts, they may be able to replace CT.

ID	Presentation Title	Lecturer	Question	Answer
03-08	Facility design of Yonsei Cancer Center Korea	Jin Sung Kim	Thank you for the presentation. What was the total budget to jump to Carbons (including facility, equipment etc.)?	Thank you for asking the practical question. It will depend on a lot of different component in each organization. - building size, building equipment, carbon therapy machine config, integration with other rad onc machine, economic situation, maintenance plan, staffing and etc. However the overall cost for our carbon project is around 300 million$ with basic building, equipments and others. It will be better to discuss with provider if you want!
03-09	Facility design of Mayo Clinic	Keith Furutani	Thank you for the presentation. I have two questions. What is the total budget for the new CIRT center? How many patients it is estimated to treat annually in the new center?	I cannot share the budget because that is business confidential. The number of potential Carbon patients in the USA was discussed in Doctor Foote's presentation at this ITCCIR. Given that Mayo Clinic Florida is the only Carbon center for the time being the numbers are therefore rather large until more Carbon centers are constructed in the USA.
03-10	What Particle Therapy Can Learn from IMRT and OtherHigh-Precision Radiotherapies	Arnold Pompos	Thank you for your teaching.Your teaching style is really interesting and the content is very professional.So I'd like to ask if you have any other course resources or accounts for knowledge sharing.We'd love to learn more about your research. Looking forward to your response。 sincerly your,	I am flattered by your comment and request. It is a great pleasure and honor for me to be part of the ITCCIR family and I am very happy to read your response. Please email me directly to "Arnold.pompos@utsouthwestern.edu" so I can better understand what your needs are and potentially help to the best of my knowledge. Thank you again.
04-01	Head & Neck Tumor	Masashi Koto	Thanks for the nice talk. Grateful if you answer the following 2 questions: 1. If the inner ear is included in treating parotid gland tumor with facial nerve invasion, what is the safe dose delivered to the inner ear to prevent hearing loss? Or hearing loss in this scenario is inevitable? 2. For mucosal melanoma, what is the optimal dose/fractions to cover the areas with melanosis?	Thank you for your questions. Answer 1. A dose of less than 40 Gy (RBE) in 16 frs. for inner ear is safe. But, in treating parotid gland tumor with facial nerve invasion, most patients develop hearing loss because of otitis media with effusion. 2. We recommend 40Gy (RBE) or more in 16 frs. to the areas with melanosis. Thank you.
04-03	Lung Cancer	Mio Nakajima	Thank you for the nice presentation. I would like to know the appropriate distance between the 4 fiducial markers and the tumor. If they are far from the tumor (like the slide shown in this presentation), can they really represent the migration range of the tumor? Thanks for your response!	Thank you for good question! You are right, and ideally, if possible, the markers should be inserted close to the tumor and out of the path of the beam.
04-03	Lung Cancer	Mio Nakajima	Is in-room CT used for lung cancer or metastases in QST hospital?	No, we do not have in-room CT. However, we would like to have one, and we are working to have it installed in the future.
04-04	Liver Cancer	Kei Shibuya	Thanks for the nice presentation. I wonder how many fiducial markers are needed before simulation (if no lipiodol deposition)? Are the markers deposited within the tumor, around the tumor or beside the tumor?	
04-04	Liver Cancer	Kei Shibuya	Thank you for the wonderful speech and sharing! As for limited-sites liver metastasis from solid tumor, without other organ invasion, will you consider carbon ion radiation as local treatment?	
04-04	Liver Cancer	Kei Shibuya	Thank you for the wonderful speech and sharing! As for limited-sites liver metastasis from solid tumor, without other organ invasion, will you consider carbon ion radiation as local treatment?	
04-06	Bone & Soft tissue Sarcoma	Reiko Imai	Thank you for the great speech! I noticed that some patients with large volume of primary tumor might present relative long time of regression process, like even for years. So how would you define the optimal evaluation time point and interval for tumor regression?	Thank you for the question. Usually, we set a 3-6 month interval of CT and/or MRI. Depending on the tumor grade, the interval is modified.
04-08	Locally Recurrent Colorectal Cancer	Hirotoshi Takiyama	Thank you for the presentation. Do you use auto contouring in your treatment plans?	No, all contouring is done manually. Local recurrence of CRC is too various to contour automatically.
04-08	Locally Recurrent Colorectal Cancer	Hirotoshi Takiyama	Thanks for the nice talk. In QST hospital, what is the percentage of recurrent rectal cancer patients receiving spacer installment before CIRT?	Thanks for your question. It's just 5% at most. Some cases could not be treated by CIRT because the surgeon judged it impossible to insert the spacer.
04-08	Locally Recurrent Colorectal Cancer	Hirotoshi Takiyama	Thank you for the great speech and experience sharing! As for those recurrent patients with photon beam irradiation within one year or two, will you consider compromised prescription dose as compared to 70.4Gy/16Fx? And for closed GI tract without spacer, how would you adjust PTV dose coverage?	It's a good question, thank you. We have not reduced the dose because we needed to investigate the local control effect of the 70.4Gy treatment (and to compare it with the 73.6Gy treatment). The results will be published shortly, and we may consider decreasing the dose based on those results. However, we must assume that the therapeutic effect will also be reduced. The worst situation that can happen is that the tumor doesn't even cure, but the patient develops adverse effects! When the gastrointestinal tract is exceptionally close, PTV coverage must be sacrificed; the task of reducing the PTV is done manually to an acceptable extent by comparing DVH. This often results in tumor recurrence from the proximity of the gastrointestinal tract, and we explain this risk to the patient before treatment.

ID	Presentation Title	Lecturer	Question	Answer
06-04	Overview of BNCT & Current status of Accelerated-based BNCT	Yoshihiro Takai	Thank you for the presentation. I was wondering what is the percentage of surrounded damaged healthy tissues with BNCT? (approx). Concerning side-effects. Are they comparable or less severe using conventional RT or CIRT?. (Theageneio Anticancer Hospital of Thessaloniki, Greece,Europe)	From the analysis of 57 cases with recurrent squamous carcinoma treated with BNCT, the rate of acute adverse events (AEs) of more than grade 3 was 27%, such as stomatitis (14%), anorexia (3%), nausea (3%), aspiration pneumonia (3%) and laryngeal edema (3%). These rates are less severe than that of conventional RT or CRT. Furthermore, all cases have had curative radiotherapy (Xray or proton) before. Hence, the rate of AEs of BNCT is that of second curative radiotherapy. Conventional photons or particle radiotherapy are not commonly used for second curative treatment as you know. Therefore, AEs (side-effects) of BNCT are much less severe than that of conventional RT or any particle radiotherapy.
06-04	Overview of BNCT & Current status of Accelerated-based BNCT	Yoshihiro Takai	thank you for your teaching！I am very interested in BNCT, so I have some questions for you. Frist, I would like to ask about the dose calculation of BNCT.Is the 'dose' concept in BNCT the same as in conventional radiotherapy? Second, BNCT produces two high-LET particles, so in principle, as long as the energy of the neutron beam is controlled, completely precise tumor sanitize can be achieved.But what other factors affect the dose of tumors and normal tissues in the actual calculation process?（I knew that the distribution of BPA had an impact on treatment, and I wondered if there were other contributing factors?） Third, what do you think is the most urgent problem to be solved and studied in terms of dose calculation? I very much look forward to hearing from you.	1.At each point of interest in the patient, one can identify four components contributing to the absorbed dose. They are boron dose, hydrogen dose produced by collision with fast neutron, nitrogen dose; this is proton dose produced by neutron capture reaction, gamma ray dose from neutron source and in the body of a patient. Among them, boron dose is the main contribution of the absorbed dose (for tumor, boron dose accounts for more than 95% of all absorbed dose). Boron dose is calculated as a proportional dose obtained by multiplying neutron fluence and boron concentration of tissue. Dose concept is completely different from conventional radiotherapy. 2.Only thermal neutrons or epi-thermal neutrons can be used for BNCT. The neutron spectrum of these neutron depends on each reactor or accelerator-based BNCT system. In BNCT, neutron energy can not be varied for each case and precise trimming of irradiation beam to tumor size and shape is also impossible. Many factors influence the absorbed dose of tumors and normal tissues, such as, neutron fluence, boron concentration and its distribution, T/N (T/B) ratio of boron concentration, cell size, N/C ratio, etc. Using FBPA-PET to obtain T/N (T/B) ratio is not reliable at present because of its very heterogenous distribution of tumor tissue, but its usefulness is currently investigating. Regarding the influence of cell size and N/C ratio to the absorbed dose has not been understood so far. 3.Precise dose should be calculated for tumor and normal tissue. Currently, many assumptions are included for the dose calculation of BNCT, so the calculation result is not real value. There is a need to be able to measure accurate boron concentrations in tumors and normal tissues on a case-by-case basis. Is FBPA-PET enough or not? Is biopsy of normal tissue such as oral mucosa is needed? Anyway, many researches are needed to resolve this problem. Regarding physical requirements for dose calculation of BNCT, ask a physicist please. I am a radiation oncologist.
07-11	Introduction of facilities Gunma University Heavy Ion Medical Center (GHMC)	Hidemasa kawamura	Thank you for the presentation. Do you think, that the Number of Staff of GHMC is adequate? (Theageneio Anticancer Hospital of Thesssaloniki, Greece, Europe)	Thank you for your question. Ideally, I would say not adequate. There are few radiation oncologists in Japan and it is difficult to increase the number. Nurses and technicians are relatively many in the Japanese situation, but it is difficult to organize shifts because treatment times are getting longer with the increase in the number of patients treated.
07-12	Clinical aspects of Hyogo Ion Beam Medical Center	Tomoaki Okimoto	Thank you for the presentation. How would you explain the fact that "carbon ion often shows better dose distribution even if gantry is not available" as you mentioned? (Theageneio Anticancer Hospital of Thessaloniki, Greece, Europe)	Thank you very much for your good question. We usually create two plans (carbon and proton) and choose the better plan. In our experience, when comparing two plans with the same beam angles, Carbon plan is usually better. Because penumbra of carbon is narrow than it of proton.
09-02	RaySearch Laboratories	—	Thank you for the presentation. Could you explain please, briefly the meaning of "Dirty dose"?	Dirty Dose and Clean Dose is a concept we have developed for RayStation. By this a plan dose is divided into two dose components. The Dirty Dose is the from energy depositions at LET above a use defined threshold (for protons a threshold of 3 keV/um can be suitable. For carbon higher thresholds should be used e.g. 50 ke/um. The Clean Dose is the opposite.- Sum of Dirty Dose and Clean Dose equals the total dose. In optimization on can define objectives that act on only the DD or only the CD. For instance, one can penalize DD in distal risk organs (typical proton use case). Another example is to increase the high LET dose in the CTV (applied to carbon therapy.